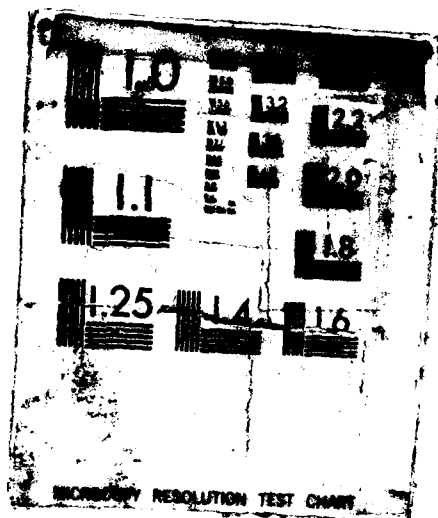


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SHEET METAL FABRICATION TECHNOLOGY ASSESSMENT

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ADDITIONAL LIMITATIONS IMPOSED ON THIS DOCUMENT  
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1.0 INTRODUCTION

The purpose of this report is to provide Aircraft Maintenance Management and Engineering information necessary to select the optimum modernization plan to update the existing sheet metal shop for the Aircraft Division, Building 375, at San Antonio Air Logistics Center (SA-ALC).

During the interim study and analysis report review of December 17, 1983, four conceptual layouts were presented to SA-ALC. It was concluded that one modernization layout would be prepared for the final report.

This report describes the methodology used in accumulating data and how these data were interpreted to derive the proposed modernization layout.

The recommendations and modernization plan to upgrade the existing sheet metal shop are based on surveys and analyses conducted by a Boeing Aerospace Operations (BAO) team representing the Materials and Processes, Facilities, and Manufacturing disciplines.

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2.0 EXECUTIVE SUMMARY

Study Purpose

The purpose of this modernization study is to provide recommendations to SA-ALC for modernizing the sheet metal facility. These recommendations include the adoption of the

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latest advancements in sheet metal fabrication equipment to improve productivity of the sheet metal facility.

#### Study Tasks

The tasks of this study were to:

1. Evaluate present sheet metal operations at SA-ALC with regard to organization, workload, and equipment to establish a basis for developing productivity improvement recommendations.
2. Study other sheet metal manufacturers' operations to determine desirable technology and equipment capabilities which could be utilized to improve the sheet metal operations at SA-ALC. This study focused on processes, equipment, workload, work flow, and organizational interfaces.
3. Develop optimum modernization plan to upgrade the present sheet metal shop in Building 375 at SA-ALC.
4. Study the present support organizational interfaces (i.e., Engineering, Planning, Scheduling, etc.), scheduling techniques, and parts accountability; and provide recommendations to minimize work stoppage, misdirected material flow, material shortages, and other parts control problems.



### Study Approach

The evaluation activity proceeded through these major steps:

1. Conducted sheet metal shop survey to evaluate and document current conditions.
2. Conducted remote site surveys to evaluate the sites' methods of operation and to ascertain if portions of their technology and techniques could be applied to SA-ALC operations.
3. Conducted equipment evaluation at SA-ALC and evaluated maintenance records.
4. Developed four sheet metal shop conceptual layouts in sufficient detail to provide estimated budgetary costs for new equipment and an indication of increased fabrication capability. Each conceptual layout allowed for integration of new machines with existing equipment and progressive elimination of obsolete machines.
5. Determined potential impact to support organization interfaces due to the large quantities of data and material required to support the proposed modernization plan.

### Summary of Findings

The recommended modernization plan was selected from the four conceptual layouts presented to SA-ALC on December 17, 1985. This plan allows for integration of new machines with existing equipment and progressive elimination of obsolete machines. Some existing machines are to be refurbished to return them to near-new capabilities. High-technology ancillary equipment is

→ Keywords: manufacturing ←  
3

recommended. This plan can be implemented in small increments so that there will be little or no impact to the sheet metal production capability during the transition period.

With the introduction of new high-technology machines and equipment in the sheet metal shop, large amounts of data (parts fabrication plans, digitized data sets, etc.), tooling, and material are required. The support organization interfaces (i.e., Engineering, Planning, Material, Scheduling, etc.) must be in a position to respond to this increased work load. Recommendations are provided to enhance support organizations' capability.

### 3.0 SAN ANTONIO FACILITY SURVEY

A survey of the Air Force Air Logistics Center in San Antonio, Texas, was conducted on August 20-23, 1985. The objective of the survey was to familiarize team members with available information on sheet metal operations, facilities, and anticipated shop work loads. Problems with the existing sheet metal fabrication shop and data processing were also noted.

Parts being fabricated in the sheet metal area of Building 375 (reference Figure 1, Sheet Metal Shop - Existing) during the survey were primarily in support of the Pacer-Lite program to replace cowlings on the B-52H. This requires SA-ALC to build replacement cowling assemblies for all of the B-52H aircraft in the inventory. In addition to this major undertaking, the sheet

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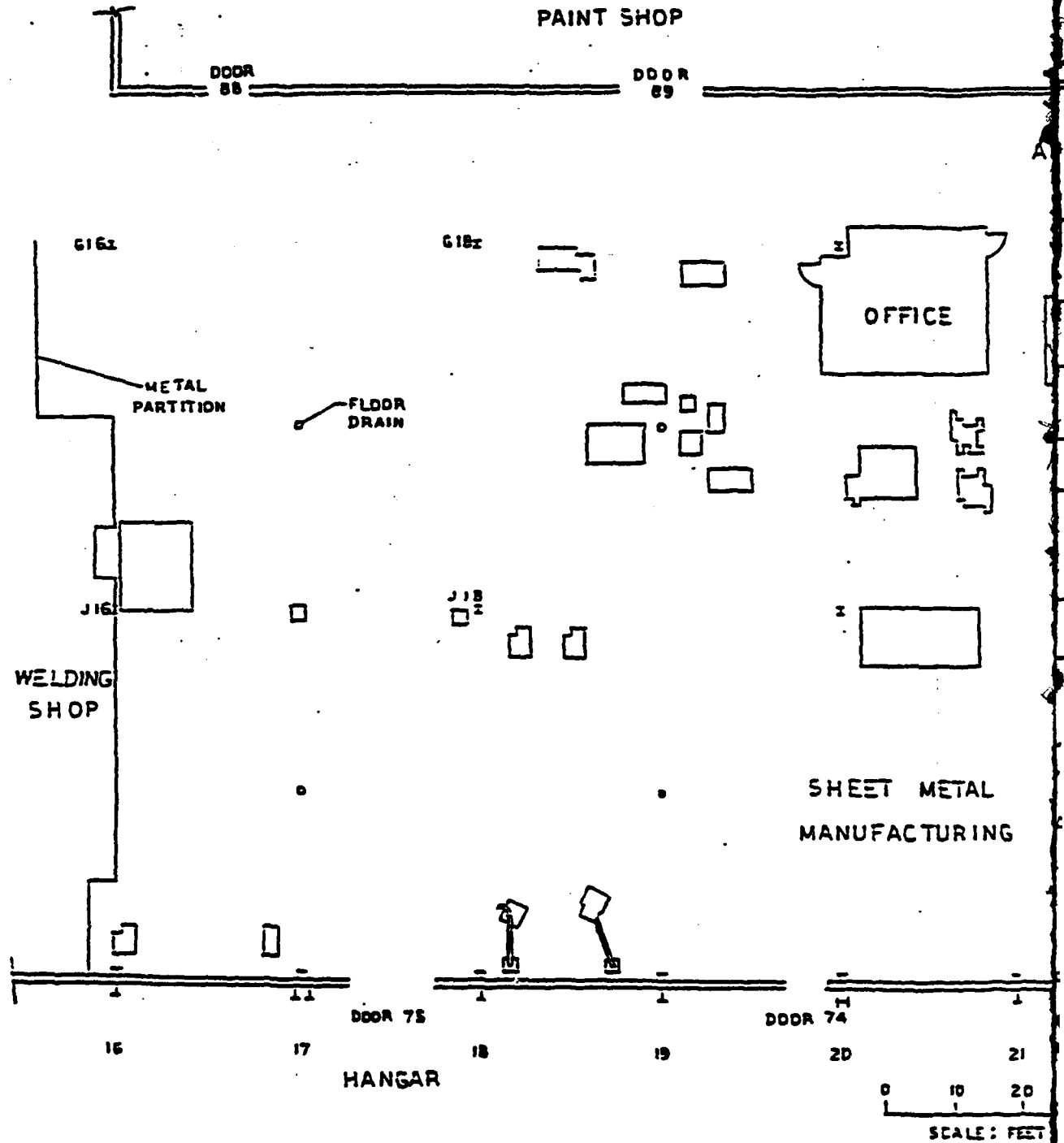


FIGURE 1 - SHEET METAL SHOP - EXISTING

PHYSICAL PLANT

DOOR 90

DOOR 91

DOOR 93

AISLE

AISLE

LATRINE

CONTROL

ROUTER  
DRILLER

HANGAR

LAYOUT  
EXISTING SHOP

DOOR 73

DOOR 72

21

22

23

24

25

26

27

10 20 30

SCALE: FEET

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metal area was also supporting Material Inventory Center (MIC) replacement and Maintenance Items Subject to Repair (MISTR) hardware.

The various processing shops (heat treat, cleaning, painting, etc.) were not surveyed. Their ability to support an increase in productivity of the sheet metal shop is not known and would be difficult to determine without detailed knowledge of current and anticipated work loads.

During the shop survey, several situations were observed which appear to be counterproductive and would not support a proposed schedule-oriented system. They were:

1. Shop mechanics devised their own tooling.
2. Parts were being made on a hydraulic press using a rubber assist on some of the tools (form block). This resulted in unacceptable flanges which required hand working to achieve a finished part.
3. Band saws had apparent excess chatter, possibly indicating the wrong type of blade. Shop mechanics indicated saw blades were not appropriate for the job at hand. Correct blades had been ordered but substitution was made during procurement.
4. Large pallets of raw material were setting idle because of:
  - Job being held because of shop "earned-hours" requirements to satisfy bookkeeping.

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- Material waiting release of job or being held waiting for other materials or parts.
- 5. There was no evidence of a controlled production schedule.
- 6. Tool proofing was not being conducted.

Poorly maintained power machines also contributed to less than optimum productivity. Those noted during the survey were:

1. Hydroform press were out of service for long periods of time.
2. Visible cracks in structural members of major machines limited the machine's capability and also presented potential personnel safety hazards.
3. There were no modern "state-of-the-art" attachments or high-technology add-ons, such as trapped rubber heads on hydraulic presses or punching capability on brake presses.

#### 4.0 REMOTE SITE SURVEYS

Remote site surveys were conducted to evaluate the sites' methods of operation and to ascertain if portions of their technology and techniques could be applied to SA-ALC operations. To perform these surveys, a BAO team representing Manufacturing Engineering, Manufacturing Planning, and Materials and Processes Engineering was organized to survey the following sites:

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Boeing Commercial Airplane Company (BCAC) - Seattle, Washington,  
September 3 through 5, 1985

Uniqueness - Automated planning and scheduling systems. This is a low lot size production operation with many lot sizes of 10 to 20 parts. BCAC's automation system controls material procurement, scheduling, shop routing, and tooling for a scheduled quantity of up to 4.6 million parts/year.

Boeing Military Airplane Company (BMAC) - Wichita, Kansas,  
September 9 through 13, 1985

Uniqueness - Insertion of single part requirements into standardized system. Conversion of multiple airframe manufacturers' drawing data (L1011, DC10, DCB, or A300) to usable BMAC working data is a major undertaking. This conversion is digitized for NC machines and put in the standard planning system (same as BCAC). The parts are then processed to the airplane in 10 to 17 calendar days.

Sacramento Air Logistics Center (SM-ALC) - Sacramento, California,  
September 24 and 25, 1985

Uniqueness - Innovations to standard Air Force regulations. SM-ALC is implementing a new parts control system which schedules work to shops on a parts-needed basis. This starts with a preplanning function which improves material procurement, defines materials for volume procurement, and reduces lost or misplaced parts and materials.

United Airlines (UAL) - San Francisco, CA., September 26, 1985

Uniqueness - Like BMAC, UAL has all airframe manufacturers represented in its inventory. UAL's is a repair and maintenance operation, whereas BMAC's is a modification operation. To meet its demands, UAL has taken standard company processes and applied them to all airframes. It also is involved in quick turnaround for repairs and has devised an organizational interface communication system. This system starts with the preplanning meeting, which defines expected requirements. Each responsible organization preplans its preliminary work on the basis of this expected requirement and is then in a position to implement work when engineering releases final data.

Machines, facilities, and craftsmen at each site were found to be basically the same. The difference in productivity is significant and is caused by the difference in requirements at each facility. Each site visited is applying new technology to its operations and facilities, each in a different manner. Many of these techniques can be applied to the SA-ALC modernization layout. Appendix A (Industrial Site Survey Technology Assessment Report) provides additional information regarding techniques and methods utilized in the various facilities.

### 5.0 EQUIPMENT EVALUATION AT SA-ALC

The sheet metal shop facilities encompass some 24,245 square feet divided into two areas: 13,300 square feet for power machines and the balance for hand operations. Machines are old, averaging 24.



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years of service. The major items of sheet metal power equipment at SA-ALC are shown in Appendix B, Table B-1. This table identifies year of delivery, spare parts availability, and other evaluation data.

Maintenance data were provided for 11 items of power equipment as shown in Appendix B, Tables B-2 through B-12. These maintenance data were evaluated to arrive at anticipated maintenance costs as illustrated in Appendix B, Figures B-1 through B-5. Analyses of these data were used to arrive at the conclusions and recommendations in Table B-1.

#### 6.0 SHEET METAL SHOP MODERNIZATION LAYOUT

##### 6.1 Production Capacity

Since baseline data were not available for the sheet metal shop parts count, part size, material, process flow, etc., the following reference documents were utilized to arrive at projected requirements and capabilities:

1. A-G013, A12-UD-MB4 MMSIP Monthly Production Count Summary/Analysis, dated June 30, 1985.
2. Analysis of Material and Parts Processing at Aircraft Division, Contract Number F41800-85-C0090, dated October 18, 1985.
3. Integrated Computer-Aided Manufacturing (ICAM) Sheet Metal Center Concept Design Volume II, Contract Number F33615-78-C-5149, dated September, 1981.

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From item 1. above and conversations with SA-ALC personnel, it was determined that the SA-ALC baseline sheet metal parts output is between 9,000 and 10,000 parts per month. An output of 10,000 parts per month will be utilized for this study. Figures 4.4 and 4.5, in Volume I of item 2. above, provide a 6-year growth projection of 21.2 percent. This figure also identifies the numbers and types of aircraft subject to SA-ALC's control during this 6-year period. Assuming that this growth would be applicable to work load growth in the sheet metal area, a 21 percent growth estimate is used for calculations.

From the supporting documents listed above, the following data were derived.

1. The present sheet metal production count is 10,000 parts per month with a total increase of 21 percent in 6-years to 12,100 parts per month. (Reference document 1. above.)

Where single-year increases are calculated, the factor of 12.84 percent will be used, which is the percent age gain from fiscal year 85 to fiscal year 86. This factor will be considered the "surge" load baseline. (Reference document 2. above.)

2. Material usage (Reference document 3. above.) percentages are as follows:

88% = Aluminum Alloys

7% = Stainless Steel

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3.8% = Carbon Steel

Balance = Titanium & Other Alloys

3. Parts shape percentages (Reference document 3. above.) are as follows:

Aluminum Parts

23% = Flat

77% = Formed

57% by Brake Press

28% by Hydroform (Guerin Rubber Form)

2.0% by Drop Hammer

2.1% by Stretch Press

10.8% Other

4. The BAO survey team considers the pacing items for improving the sheet metal shop capability to be the NC router and the NC profile punch press. Users of this equipment and the supplier data indicate the following parts-per-hour capability based on a .080" x 10.0" x 10.0" aluminum part.

#### NC ROUTER

Sheet size 48" x 96"

Single-Sheet Lead = 38/hour

Five-Sheet Lead = 178/hour

Ten-Sheet Lead = 380/hour

#### NC PROFILE PERFORATOR PUNCH PRESS

Single-Sheet Lead = 38/hour

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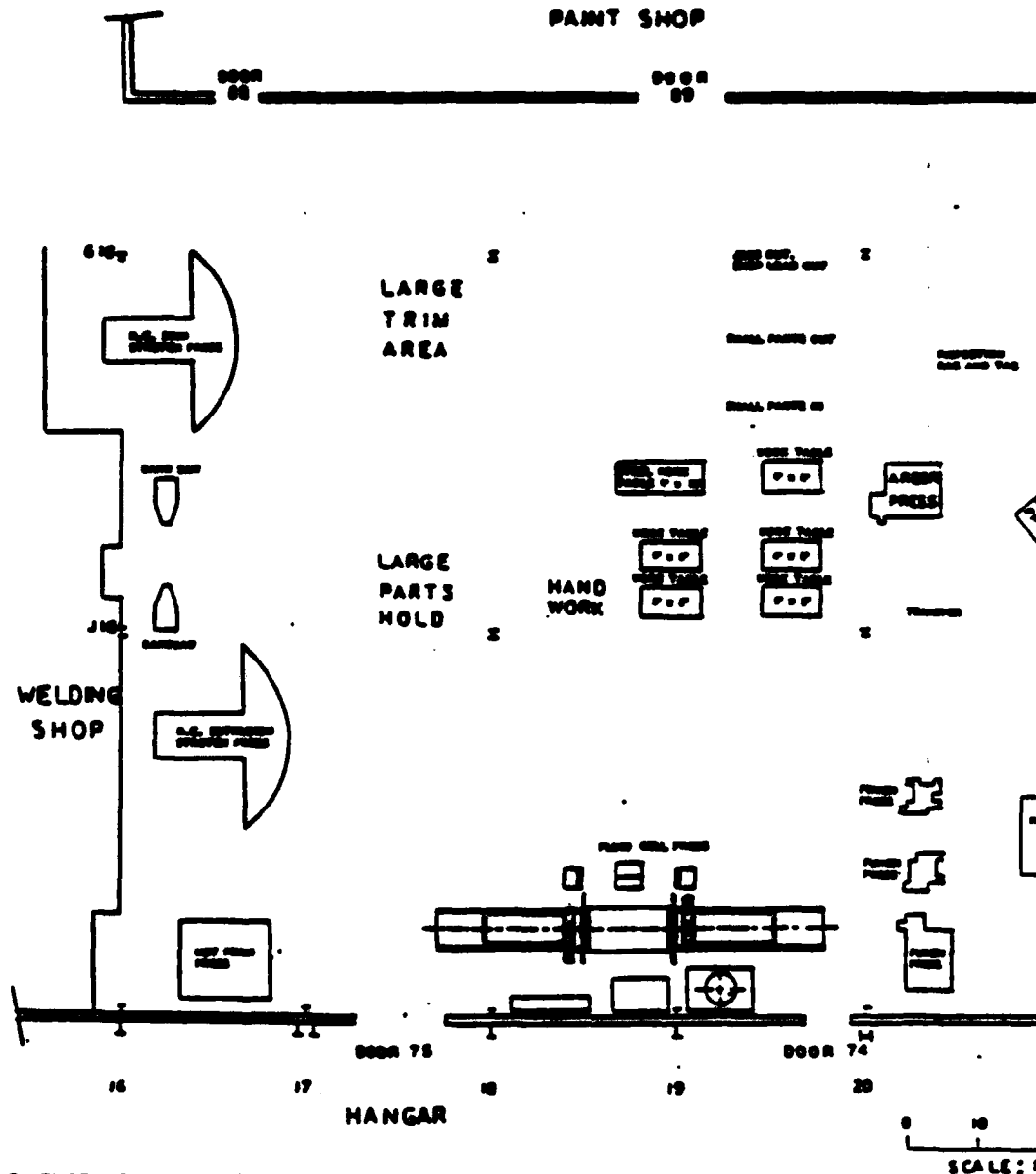
These values are conservative and will vary based on data processing, flow patterns, material, shop mechanic skills, and processing shop support. These data have been used to calculate the potential increased fabrication capability as shown in Figure 2, Sheet Metal Shop Modernization Layout, and in Figure 3, Parts Data.

#### 4.2 Recommended Modernization Plan

To assist SA-ALC management in the selection and justification of the most appropriate facility, cost estimates for new equipment were prepared for both the existing facility and a new facility. Four conceptual layouts were prepared: two layouts for the existing facility and two for a proposed new facility.

Each conceptual layout allowed for integration of new machines with existing equipment and progressive elimination of obsolete machines. The layouts could be implemented one at a time with minimum impact to ongoing sheet metal production. At the interim review in December 1985, after reporting the cost for each layout, SA-ALC direction was given to concentrate on estimating the updating of the existing facility.

The existing sheet metal shop is not designed for an optimum flow of parts. The modernization layout repositioned most major items of equipment for optimum flow of parts and material through the shop. The Hyde press, 500-ton press, and Arber press were not relocated because of subfloor installation.



**NOTES:**

- (1) EXISTING SHOP, NEW MACHINES INSTALLED TO UPGRADE CAPABILITY WITH SELECTED OLD MACHINES AS BACKUP, ADDED MATERIAL STORAGE AND NEW OFFICE SPACE.
- (2) DROP HAMMER TO REMAIN AS IS.

**FIGURE 2. SHEET METAL SHOP MODERN**



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PART COUNT DATA (A)			
PART FORM METHOD	EXISTING PART QTY PER MO.	GROWTH ESTIMATE PER MO.	PARTS CAPABILITY PER MO.
HYDROFORM	2,156	2,609	5,440 & <
BRAKE PRESS	4,389	5,311	8,400 & <
FLAT PARTS	2,300	2,783	18,200 & <
DROP HAMMER	154	186	280 & <
OTHER			
• NC EXTRUSION	0	416	500 & <
STRETCH PRESS			
• NC SKIN	0	196	280 & <
STRETCH PRESS			
• HOT FORM	0	280	320 & <
• DEEP DRAW	280	280	280 & <
• HAND WORK, ETC.	721	40*	-
<u>TOTAL</u>	10,000	12,101	33,700 & <

PART COUNT DATA (B)			
SHAPE FLAT PARTS	EXISTING PART QTY PER MO.	GROWTH ESTIMATE PER MO.	PARTS CAPABILITY PER MO.
NC ROUTER	0	4,700	4,900 & <
NC PROFILE PUNCH PRESS	0	2,700	4,900 & <
SHEARS & OTHERS	10,000	4,700	8,400 & <
<u>TOTAL</u>	10,000	12,100	18,200 & <

\*PART COUNT IN THIS AREA WILL DROP.  
PARTS WILL BE MADE ON NEW EQUIPMENT.

FIGURE 3 PARTS DATA

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The modernization layout is shown in Figure 2, Sheet Metal Shop Modernization Layout. This plan can be implemented in small increments.

1. The major items for increasing sheet metal parts production are the NC router, NC profile punch press, debur machine, and translator digitizing system. The NC router and punch press will greatly facilitate the shaping of sheet metal parts, and the translator digitizing system will supply digitized data sets to the NC machines. The debur machine will greatly reduce the flow time and labor to brake and debur parts.
2. Since hydroform parts are more labor intensive although fewer in count, hydroform presses will require updating prior to making improvements in the brake press process. The new hydraulic press with a trapped rubber head and two feed tables should be put into operation, and then the 500-ton hydraulic press should be refurbished with a trapped rubber head and two feed tables added. This improvement will considerably increase the press's hydroforming capabilities, thus allowing it to handle the expected increase in part count. This will contribute significantly to the reduction of handwork man-hours.
3. The brake form capability will be improved with one 12-foot NC brake press, one 6-foot NC brake press, and one 4-foot NC brake press. In addition, unitized punching



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tools for pilot holes are required. The addition of this equipment will allow the brake form to handle the required increased part count but will require the addition of a new NC shear to cut raw material to flat pattern sizes.

The following new equipment has been identified to increase the shops' capability to produce sheet metal parts which are not presently being fabricated at SA-ALC but will be required for future modification work on both present- and new-generation aircraft:

1. NC Extrusion Stretch Press.
2. NC Skin Stretch Press.
3. Hot Form Press.
4. Fluid Cell Press.

To support the new NC machines, the organization responsible for the layout of flat patterns and other tooling will require a Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) terminal. This terminal should interface with the proposed digitized system which converts hardcopy drawings to digitized data sets. The CAD/CAM terminal will be typical of those now in use for NC mills and lathes and will allow tapes to be organized for the NC router and punch press. The terminal should be equipped with: (1) software programs to make data sets for routing flat patterns for both airframe and commercial air conditioning ducts, and (2) software that will interface with the

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NC machines and also the plotters. The CAD/CAM system will not be a primary system but will be utilized as a backup system to preclude work stoppage for lack of data sets or other digitized data.

### 6.3 New and Modified Machines

The new and modified machines recommended for use in the modernization plan are listed in Appendix B, Tables B-13 through B-15. Data provided included:

1. Rough Order of Magnitude (ROM) Cost (FOB Supplier).
2. Expected Delivery Time Frame.
3. Consumables.
4. Electrical Power Requirements.

New equipment data contained in the matrices are based on teleconference inquiries with equipment suppliers during the last quarter of 1985. Prices are subject to change without notice.

The retained and modified equipment recommended for use in the modernization plan is based on data from historical maintenance records (Tables B-1 through B-12 and Figures B-1 through B-5), cost estimations from refurbishment firms, machine replacement values, and engineering judgement from visual observations.

One copy of layouts, calculations, and original vendor data used in preparation of this report will be catalogued and furnished at the time of submittal of the final report.

## **7.0 SUPPORT ORGANIZATION INTERFACES**

### **7.1 Conclusions**

The following observations, derived from the technical team survey and the foregoing technical discussion, are offered to further the process of modernization of the sheet metal shop. Installation of NC equipment (brake and punch presses) and trapped rubber heads for new or existing equipment will greatly increase the capability to fabricate sheet metal parts and will meet or exceed the 21 percent growth estimate. Large quantities of data and material will be required to support the proposed new sheet metal facility. The support organizations that will be impacted the most by the new equipment are as follows:

**ENGINEERING** - Increase capability to allow part programming, develop digitized data, and design tooling (special tools, form blocks, etc.).

**PLANNING** - With the increase in sheet metal parts production and use of high-technology machines, the primary concern is the requirement for a master schedule based on part need date. Job planning should include specification of materials, designation of form blocks, machines, processes, and process sequence.

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- SCHEDULING** - The job planning data should provide the basis for preparing and maintaining a master schedule for parts flow through the shops. Automatic Data Processing (ADP) will simplify integrating new tasks and coordinating tool availability, material, and manpower.
- MATERIAL** - ADP planning will enable accurate record keeping and assist in projection of material usage so that proper inventories can be established and maintained.
- SHOP** - Select key people for training at factory schools
- SUPERVISION** and then cross-train backup personnel.
- FACILITIES/** - Establish maintenance schedules for new machines and
- MAINTENANCE** train key personnel to new high-technology requirements. Provide maintenance data for integration with hardware production scheduling.
- DATA** - Update/develop standard automated planning system
- PROCESSING** to work with master schedule. Develop retention and retrieval system for digitized data converted from engineering drawings.

TRAINING/ - Training on new high-technology equipment should  
CERTIFICATION be part of the purchase agreement. At present, no  
certification requirements are needed. For new NC  
machines, trained operators are required and their  
proficiency must be maintained and documented.

## 7.2 Recommendations

The following recommendations are derived from technical team  
surveys, the modernization layout of Figure 2, and the foregoing  
technical discussion. Specific recommendations are as follows:

Engineering - SA-ALC engineering makes parts for many different  
types of aircraft, each with a different drawing system (e.g.,  
Boeing (B52), Lockheed (C5A and C130), etc.). With the  
introduction of data sets it becomes a major task to convert this  
diversified data to a machine compatible language. A layout  
specialist group will be required to translate these company  
drawings to usable language data for the machine. This group will  
provide the data necessary to define a flat pattern from hardcopy  
for routing on the NC router or profile punch press. This group  
will also arrange the parts on sheet stock to control scrap and  
provide the data to the operators through tape or computer  
storage for NC operation. All tapes for the NC router will be  
prepared by this group. They will also be responsible for storage  
of the electronic data and to build a data base for future use.

Layout specialists can also support other organizations such as tooling, by scribing or routing headers for a master model to be used in drop hammer or fiberglass fabrication. Also, layout specialists can provide building maintenance with data sets of air conditioning transitions, plenums, etc., or provide full size mylar copies of data to be used for making drill tools, hand routers, and assembly fixtures. A specialist is needed who understands design requirements for appropriate tools to work with the new generation NC equipment.

Planning - A master schedule based on part need date should be developed. Detailed planning for each part which includes material, tool, machines, processes, process sequence, and part flow through the shop should be formulated for consistency. Each part should be assigned a code number, i.e., a series of numbers or letters for automatic data processing. The number should indicate such parameters as designated machine, processes, surface finishes, material shape, chemistry, dimensions, tolerances, lot size, etc. This information provides the foundation for a data base which has broad applications. Since SA-ALC makes parts for the B-52, C5, and C-130 aircraft, each with different types of drawing systems, the data base can be used to group parts by common characteristics, which in turn, makes it possible to eliminate unnecessary planning. Such a system has been demonstrated to reduce the time required for planning by as much as 80 percent.

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The survey team reviewed planning and scheduling systems during the remote site surveys. Standardization is the key. The systems surveyed were based on repeating the same functions over and over and doing it the same way every time. BCAC standardized each activity. Individual methodologies were discarded. This system was then converted to usable software and sheet metal planning became standard and automated.

With the new machines at SA-ALC a similar system should be employed. The changes need to be internally reviewed and made an integral part of the modernized sheet metal operations.

Scheduling - Scheduling must control parts flow through the shops, i.e., when parts will be at specific locations, how long they are to be in that location, and what the "hold up" is if they fail to move. With this system "bottle necks" and "work stoppages" occurring from lack of data, material, or manpower become highly visible.

Material - With automated planning and scheduling in place, the materials function must also become automated. Part count, quantity, material, etc., are easily assessable allowing identification of trends. Once these trends are identified, quantitative analysis can be made which will assist in projection of material usage so that proper inventories can be established and maintained.

Shop Supervision - Training of personnel to be specialists and assuring backup personnel availability is crucial to a schedule-sensitive system. New technology requires greater knowledge with regard to utilization and training of personnel.

Facilities Maintenance - With NC machines as primary drivers for scheduled production it becomes vital to assure the machines operate at optimum levels. Scheduled preventative maintenance is the key to long runs with minimum down time. Maintenance should become a part of master scheduling.

Data Processing - This system will automatically be revised as other organizations automate or apply electronic systems. The main concern of this operation is to assure standardization. This means that each organization's data processing will interface with the others. An individual from engineering, planning, or scheduling should be responsible for maintaining uniformity and standardization for the data system.

Training/Certification - Training will be divided into two sections for the new electronic systems. Both operators and maintenance personnel should be factory trained by the equipment manufacturer and will then become instructors for others. Maintenance personnel, requiring factory training, will be used to keep machines in service, to train other maintenance personnel, and establish the milestones for preventative maintenance on the master schedule.



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APPENDIX A

INDUSTRIAL SITE SURVEY TECHNOLOGY  
ASSESSMENT REPORT

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INDUSTRIAL SITE SURVEY  
TECHNOLOGY ASSESSMENT REPORT  
SEPTEMBER 3-26, 1965

The industrial site survey assessments, reported in this document, were requested by the SA-ALC/MAB, Kelly AFB, San Antonio, Texas 78208, under Government Contract Number F41800-68-R7346; however, it does not necessarily bear the endorsement of the requesting agency.

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**ABSTRACT**

The industrial site surveys were conducted by a SAG team to evaluate their sheet metal fabrication methods, procedures, data processing, and equipment; and to ascertain if portions of their technology, technique, operations, and facilities could be applied to update the SA-ALC sheet metal operations.

## 1.0 INTRODUCTION

The primary objective of the site surveys was to familiarize team members with the sheet metal fabrication methods and data processing at SA-ALC and then survey the industrial sites in the areas of process equipment, workload, work flow, organization and organizational interfaces. BAO will evaluate their methods of operations to ascertain if portions of their technology and techniques can be applied to SA-ALC operations.

## 2.0 SITE SURVEYS

### 2.1 Boeing Commercial Airplane Company (BCAC) Survey

BCAC is the largest commercial aircraft manufacturer in the world. Their sheet metal operations are set up to support delivery of new aircraft. They produce a very large volume of sheet metal parts; however, most job orders processed through the shop are for 10 to 20 parts/part number. The sheet metal fabrication facilities are located in Plant II, Seattle, Washington.

The procedures used to identify and control flow of sheet metal through the system were presented by the Industrial Engineering Office. The concept is based on a master schedule with each organization providing their service in a timely manner to produce parts on schedule. Pressure is placed on the schedule when one or more groups increase their capability and, therefore, put forth a requirement for the interfacing group's improvement. This system has forced planning to join the high-technology environment.

Past planning methods were explained. The only uniformity was that Boring processes were used and some standard tools were available. The requirement for increased efficiency changed this method of operation to a standardized system. Research was implemented and a system devised which made all sheet metal planning uniform. Tools were catalogued and, where possible, defined as a standard. A methodology was developed for sequencing the part through the shop and allowed planning to reduce the flow time through the shop by 80 percent. The overall effect on the part production improvement curve is still being assessed. It is, however, known that besides reduced planning time, gains were made in:

1. Estimating need for tools and their cost.
2. More legible shop paper (machine typed versus handwritten).
3. Standardization of tools by families.
4. Reduced errors in Routing, Labor Standards.
5. Repeatable for follow-on lot orders.

These changes were dramatic in changing the format and output of production planning, but the organizational manpower remained constant. Experienced personnel were used to compile data, while others were retrained to use the high-technology machines and equipment.

### **ADVANTAGES**

This system is simple and has many features that could be implemented at SA-ALC. It will require realigning interfaces and organizational responsibilities. Some items which should be considered for incorporation into the SA-ALC sheet metal operations include:

1. Standardization in design, planning, processes, and parts manufacturing.
2. The planner must plan each job from start to finish, which includes specifying materials and dedicating specific machine tools (existing/new), form blocks, machines, processes, and the manufacturing of parts to a predetermined schedule.
3. Each part should be assigned a classification number or code number, a series of numbers or letters which can be handled by a computer. For example, it would include machine operations, surface finishes, material shape, chemistry, dimensions, tolerances, lot size, etc. This information provides the foundation for a data base which has broad applications. Since SA-ALC makes parts for the B-52, C5, and C-130 aircraft each with different types of drawing systems, the parts can be grouped by common characteristics, which in turn, makes it possible to eliminate unnecessary planning duplication. This has been demonstrated to reduce the time for planning by as much as 80 percent.

4. Parts of the BCAC system, when integrated with the SA-ALC system, could provide the needed improvement to support change and could possibly be software programmed into existing equipment. The standardization and uniformity alone would reduce misinterpretation by interfacing organizations and provide a smoother, quicker transmission of data. The system is geared to accept "surge loads" and, in most cases, without premium time being allocated.
5. BCAC's primary driver "Production Schedule" was evident in the warehousing of material, movement to the machines, and the routing of tools to machines.

## 2.2 Bosong Military Airplane Company (BMAC) Survey

BMAC is primarily a large aircraft modification center for military aircraft and large commercial airplanes. Their flight line appears to be an international airport with all types, sizes and vintages of aircraft represented. In some cases, parts and aircraft were being repaired to foreign flight regulations. They also build the cabin sections for the 737, 757, and 767 airplanes for BCAC.

The primary concern at BMAC was utilization of machines and facilities when the quantity of parts might be one or two and the schedule on the planning card was ASAP-ADG.

BMAC is a smaller, more diverse sheet metal fabricator than BCAC. Diverse machines such as: NC Laser routers, Linemill Tracer Water Cutter routers, special designed routers to profile extensions, and shop controlled digitizer systems were used. These allow efficient utilization of material and the placement of AOG parts into the flow without jeopardizing planned schedules. When the shop or workload capability is calculated, the allotted time is so close to actual time that any break in the system creates large backlogs. This has made it necessary to develop a comprehensive preventative maintenance system and machine replacement program which allows the sheet metal shop to support the high volume quantities their programs require.

Computer Numerical Control (CNC) machines and Numerical Control (NC) machines require large amounts of data and large quantities of material. Digitized systems are controlled by and dedicated to support the sheet metal shop in fabrication of spare parts for all types of military and commercial aircraft, both U.S. and foreign. Boeing maintains approximately a 3-month supply of material based on the current use rate. Material availability status is basically computer controlled and is monitored very closely. Boeing usually contracts with a vendor to supply their material for a specific period of time. The vendor monitors the use rate and keeps the material at a specified level.

Boeing has standardized all their Engineering, Planning, and Manufacturing operations which allows BMAC and BCAC to have the same data processing operation. BMAC is geared to make small



quantities of parts with minimum tooling and yet maintain a large product support capability for BCAC.

ADVANTAGE

1. Same as BCAC.
2. Note: The digitizing system at SA-ALC to input data to the new NC machines should be dedicated to or controlled by the sheet metal operation. Any interruption of data flow to the machines will result in a large backlog of orders very quickly. A disruption of material supply can also result in increased backlog.

2.3 Sacramento Air Logistics Center (SM-ALC) Survey

This survey was an opportunity to study a companion Air Force Logistics Center operation using the same regulations as SA-ALC and ascertain if innovations were being used which could be applied at SA-ALC operations.

This logistic command supports the A10, F111, and B-52 aircraft. Their operation parallels SA-ALC but innovations have been implemented to efficiently use their machines.

Scheduling and routing is in the process of implementing a change to a "Kit" method. This system routes all orders and material to the "Kit" area, the orders and materials are then released to the work area on a schedule need requirement not on an "earned-hour" value or some other priority.

Template layout requirements are also provided by a template layout group. These draftsmen prepare all templates for the brake presses, router, headers in master models, and locate features for assembly tools. They also design tools, prepare tapes for NC punch presses, develop flat patterns, and define material quantities for production runs.

The NC punch press was the leading item in the sheet metal fabrication area. The addition of a trapped rubber head to an old hydraulic press and automatic loading devices, along with a "follow a line" battery-powered mule, are examples of innovative improvement.

SM-ALC personnel were very inquisitive about other operations in other places, and talked briefly of developing an Air Force Logistics Center (AFLC) quarterly meeting to exchange ideas.

#### ADVANTAGE

1. Planning provides the sheet metal craftsmen with the data, material, and tools, if required, so their time can be devoted to making parts.
2. Planning is scheduling the work to a master parts schedule.
3. Their digitizing system is dedicated to sheet metal operation. This works very well for SM-ALC with no problems reported.

#### 2.4 United Airlines Survey

United Airlines is a large commercial airline company. Their primary task is scheduled maintenance of commercial airplanes to maintain a passenger movement schedule.

This survey was short but informative. Most maintenance is on major engine components, landing gears, brakes, control surfaces, etc. They have major spares and change out of flaps, gear doors, entry doors, cargo doors, etc. Their priority concerns are record keeping and engineering planning for timely identification of requirements and fabrication of repair parts. They have standardized their sheet metal processing procedures and manufacture sheet metal parts to one standard regardless of aircraft type used: i.e., Boeing, Lockheed, McDonald Douglas, Air Bus, etc. They have coordinated with the major aircraft manufacturers to assure their processes and procedures meet or exceed their requirement. The main sheet metal schedule potential problem is a single failed item caused by ground handling, cargo loading, or other small quick fix items. To handle these problems, a communication system is set up through Engineering and requirements are prepared. Working in parallel, Purchasing is procuring material and the shop is gathering, designing, or fabricating assist tooling. When Engineering is ready each organization has standardized methods to process sheet metal in their area, allowing a short response time.

ADVANTAGE

1. Standardized sheet metal processing procedures and parts manufacturing.
2. The quick response time between Engineering, Planning, Material, and the sheet metal shops to handle fixes.

2.3 Summary

Each of these facilities have unique application of sheet metal fabrication. Machines and facilities, at each site surveyed, were reviewed and evaluated. Machine types and craftsmen of all sites were basically the same. The differences in productivity are significant and the methodology used to achieve the end item productivity is equally diversified. Each site has applied new technology to their facility, each in a different manner.

One specific question asked at each site surveyed was, "What is the best way to increase productivity in your shop"? They all gave one basic answer. Give the shop craftsmen complete planned jobs with the required tools (special tools, form blocks, etc.) and materials at his workstation so he can keep his machine busy making parts. The second answer was give him the best equipment possible to work with.

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APPENDIX B

TABLES AND FIGURES FOR MACHINE MATRIX  
AND MAINTENANCE DATA ON MACHINES

TABLE B-1 SA-ALC SHEET METAL POWER EQUIPMENT

PAGE 1 OF 4

ITEM	NOMENCLATURE	SIZE & IDENTIFICATION	MANUFACTURER	YEAR OF DELIVERY	SPARE PARTS AVAILABILITY	CANDIDATE ATTACHMENTS	RECOMMENDATION
1 D	HYDROFORM PRESS HYDRAULIC FLEXIBLE DIE	2,750 TON 25" BLANK CATALOG NO. 70-300F- 005-1	CINCINNATI MILLING MACHINE COMPANY	1972	VERSON ALL STEEL PRESS CO. CHICAGO, ILLINOIS 312-734-8200 (NO ONE PLANT SERVICES MECHANIC FAMILIAR WITH TOTAL MACHINE)	NONE	MAINTAIN
2 D	PRESS HYDRAULIC	250 TON SERIAL NO. C-2018	WILLIAM WHITE & CO. 700 THIRD AVE. MOLINE, ILLINOIS 61265 309-797-7650	1944	SAVE AS ORIGINAL. GARLOCK PACKING AVAILABLE ON SHELF FABRICATE WELDMENTS IN LIEU OF CASTINGS. THREE MONTHS DELIVERY. CONTACT DAVE THOMAS.	TRAPPED RUBBER HEAD. USE RUBBER WEAR PAD FROM MOSITES RUBBER CO.	MAINTAIN. TEMPORARY REPAIR OF CRACKED CASTINGS. INSTALL NEW WELDMENTS BEFORE USING TRAPPED RUBBER HEAD.
3 D	PRESS HYDRAULIC	220 TON SERIAL NO. 1495	LAKE ERIE ENGINEERING BUFFALO, N.Y.	1939	B-H PRESS CORP. 4065 STENTON AVE. PHILADELPHIA, PA. 19144 215-843-3434 PARTS MANUAL AVAILABLE \$225 APPROXIMATELY CONTACT BILL PULLAR	SAVE AS ABOVE.	MAINTAIN FOR OPTION 1 ONLY. SALVAGE OTHERWISE.
4 D	PRESS	500 TON CONTRACT F09603-72-C- 4836 CATALOG NO. C-4037 MOBEL SORT	WILLIAM WHITE & CO. 700 THIRD AVE. MOLINE, ILLINOIS 61265 309-797-7650	1973	SAVE AS ORIGINAL. NEW POSITION TRANSDUCER AVAILABLE 12-14 WEEK DELIVERY.	SAVE AS ABOVE.	MAINTAIN.
5 D	PRESS BRIDGE	150 TON 12 FOOT 3" STROKE CATALOG NO. 12 FM 150 SERIAL NO. 72292	WISCONSIN MACHINE CORP. WEBFORD, WISCONSIN	1972	ORIGINAL MANUFACTURER NO LONGER IN BUSINESS. NO SUPPLIER OR SPARE PARTS IDENTIFIED. MAY BE MAINTAINED BY CONTRACTOR CAPABLE OF FABRICATING CUSTOM COMPONENTS.	CUSTOM BUILT PRESS PLATES TO PUNCH HOLES IN LONG WAGON HOLE PATTERN.	SALVAGE
6 D	PRESS BRIDGE	50 TON 6 FOOT THROAT 3" STROKE CATALOG NO. 6 FM 75 SERIAL NO. 74507 3441-00-812-5217	WISCONSIN MACHINE CORP. WEBFORD, WISCONSIN	1940	SAVE AS ABOVE.	NONE	MAINTAIN

D - MAINTENANCE DATA SUPPLIED

TABLE B-1  
SA-ALC SHEET METAL POWER EQUIPMENT

PAGE 2 OF 4

ITEM	NUMERICALURE	SIZE & IDENTIFICATION	MANUFACTURER	YEAR OF DELIVERY	SOURCE PARTS AVAILABILITY	CANDIDATE ATTACHMENTS	RECOMMENDATION
7	PRESS BRAKE	360 TON 12 FOOT THROAT CONTRACT NO. 3441-82 3441-80-277-2106 U.S.A.F. 805668	CINCINNATI SHAPER CO.	1942	PARTS AVAILABLE FROM CINCINNATI INC. CONTACT NICE BROSCH 513-367-7100. NEEDS SERIAL NO. METAL STAMPED FRONT VERTICAL FACE OF RED RIGHT HAND SIDE. NUMBERS 5/8" TO 3/4" HIGH 4 OR 5 DIGITS.	NONE	MAINTAIN
8	SHEAR	12 FOOT 3/8" MILD STEEL 24" THROAT DEPTH CONTRACT NUMBER F09503-72-C-4452 CATALOG NO. S-0612 SERIAL NO. 40941	LOGGE AND SHIPLEY CO.	1972	HEER-VOSS CORP. 14111 STREET CALARY, PA. 16024 MANUAL AVAILABLE \$20 APPROXIMATELY GREEN LIGHT DISCONTINUED. GREEN LIGHT COULD BE RENOVATED BY OUTSIDE CONTRACTOR.	NONE	MAINTAIN
9	SHEAR	12 FOOT 3/8" MILD STEEL 3445-00-262-4243 CATALOG NO. 0612 SERIAL NO. M-175-9 U.S.A.F. 805676	COLUMBIA MACHINERY & ENGINEERING CORP. HAMILTON, OHIO	1950	NO SUPPLIER IDENTIFIED. MAY BE MAINTAINED BY CONTRACTOR CAPABLE OF FABRICATING CUSTOM COMPONENTS.	NONE	SALVAGE
10	PUNCH PRESS	CONTRACT NO. 3443-6 3443-00-490-9118 U.S.A.F. 805689	ROPER WHITNEY METAL TOOLS ROCKFORD, ILLINOIS	OLD	NO SUPPLIER IDENTIFIED.	NONE	SALVAGE.
11	PUNCH PRESS	55 TON SERIAL NO. UPPER LEFT HAND BY GLBS. GOLD TAG. 3143-LO-24975-2153	MALSH PRESS & DIE CO. CHICAGO, ILLINOIS DIVISION OF AMERICAN GAGE AND MACHINE CO. 1222 SOUTH MORGAN FOREST PARK, ILL. 60130 312-378-6700	OLD	MANUAL AND PARTS ARE AVAILABLE FROM ORIGINAL SUPPLIER. NEED SERIAL NO. TO ORDER PARTS.	NONE	MAINTAIN.

D - MAINTENANCE DATA SUPPLIED

TABLE B-1  
SA-ALC SHEET METAL POWER EQUIPMENT

PAGE 3 OF 4

ITEM	NOMENCLATURE	SIZE & IDENTIFICATION	MANUFACTURER	YEAR OF DELIVERY	SPARE PARTS AVAILABILITY	CANDIDATE ATTACHMENTS	RECOMMENDATION
12	PUNCH PRESS	SIZE NOT AVAILABLE U.S.A.F. 302033 SERIAL NO. STAMPED LEFT OR RIGHT SIDE OPPOSITE CONTROLS TYPICAL NO. MP-XXXX-TR M-XXXX-TR	E. M. BLISS CO.	OLD	ORIGINAL SUPPLIER CUSTOMER SERVICE 616-940-3389 MANUALS AND SPARE PARTS AVAILABLE.	NONE	MAINTAIN.
13	PUNCH PRESS	150 TON 30" STROKE 4" ADJUST 24" SHOT HEIGHT 10 STROKES/MINUTE CATALOG NO. F1150-4 U.S.A.F. 806044	CLEARING MACHINE CO. 6499 N. 66TH ST. CHICAGO, ILL. 60630	OLD	ORIGINAL SUPPLIER FIELD SERVICE 312-767-8700 MANUALS 3-6 WEEKS 1500 TO 5000 STOCK CLUTCH AND BRAKE PARTS. FABRICATE STRUCTURAL PARTS. NEED SERIAL NO. VR-XXXX (1930) VR-XXXX (1944)	NONE	MAINTAIN.
14	PUNCH PRESS	23 1/2 x 15 TON SERIAL NO. 31274	NIAGARA MACHINE & TOOL WORKS, NORTHLAND & LONGVIEW AVES., BUFFALO, N.Y. 14211 716-893-0070	1935	ORIGINAL SUPPLIER	NONE	MAINTAIN.
15	PUNCH PRESS	71 TON 4" STROKE 15.75" SHOT HEIGHT 3" ADJUSTMENT 42 STROKES/MINUTE CATALOG NO. AA-172 SERIAL NO. 31906	NIAGARA MACHINE & TOOL WORKS, NORTHLAND & LONGVIEW AVES., BUFFALO, N.Y. 14211 716-893-0070 MESSERHOFF, HELMS & CO. HOUSTON, TEXAS	OLD	ORIGINAL SUPPLIER (NIAGARA) REPAIR PARTS AND MANUALS AVAILABLE. STRUCTURAL PARTS NOT AVAILABLE FROM SUPPLIER. 1 TO 8 WEEKS DELIVERY STRUCTURE MAY BE MAINTAINED BY CONTRACTOR CAPABLE OF FABRICATING CUSTOM COMPONENTS.	NONE	MAINTAIN.

D - MAINTENANCE DATA SUPPLIED



TABLE B-1  
SA-ALC SHEET METAL POWER EQUIPMENT

PAGE 4 OF 4

ITEM	DESCRIPTION	SIZE & IDENTIFICATION	MANUFACTURER	YEAR OF DELIVERY	SPARE PARTS AVAILABILITY	CANDIDATE ATTACHMENTS	RECOMMENDATION
16	PUNCH PRESS	NOTEX CATALOG NO. 20 CND 15 TON 26" THROAT 27/32" HOLE IN MILD STEEL 3445-312-5212	NOTEX PUNCH COMPANY, INC. 2350-B ALVARADO ST. SAN LEANDRO, CA. 94577 415-357-3600	1974	ORIGINAL SUPPLIER SERVICE REP. JOHN SHIVER PARTS, MANUALS AND SERVICE AVAILABLE.	NONE	REPLACE ITEMS 16 AND 17 WITH NEW MC PROFILE FABRICATING PUNCH PRESS. KEEP ITEMS 16 AND 17 AS BACKUP DURING LEARNING PROCESS OF USING NEW MC MACHINE
17	PUNCH PRESS	STRIPPIT 18 TON 16" THROAT 25" MAX. THICK MATERIAL CATALOG NO. 18/30 SINIC 76000 SER. NO. 47663072 CONTRACT NUMBER F09603-72-C-0606	STRIPPIT MONDAILLE ARMON, N.Y.	1972	ORIGINAL SUPPLIER CALIFORNIA SERVICE CENTER 716-642-4611 PARTS - PETER FELTS PARTS SHIPPED FROM ARMON, N.Y. FIELD SERVICE EVALUATION JOHN POTERA EXT. 281	STOCK TOOLS FROM STRIPPIT	
18	BAWD SAW	DO ALL 36" THROAT 234" BLADE 1290 FEET/MINUTE 3405-00-525-0609 SERIAL NO. 31-52501	DO-ALL ATLANTA, GA. 404-608-4114	1982	DO-ALL 12122 MADISON ST. SAN ANTONIO, TEXAS 78216 SERVICE REP. BOB GREGG 512-349-0740 WELD SHOP AVAILABLE. REPAIR PARTS AVAILABLE.	NONE	MAINTAIN.
19	BAWD SAW	DO ALL 36" THROAT 234" BLADE 1290 FEET/MINUTE CONTRACT NO. F09603-82-C-6072 SERIAL NO. 399-83491	DO-ALL ATLANTA, GA. 404-608-4114	1982	DO-ALL 12122 MADISON ST. SAN ANTONIO, TEXAS 78216 SERVICE REP. BOB GREGG 512-349-0740 WELD SHOP AVAILABLE. REPAIR PARTS AVAILABLE.	NONE	MAINTAIN.
20	DROP HAMMER						MAINTAIN.

D - MAINTENANCE DATA SUPPLIED

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**TABLE B-2 MAINTENANCE DATA - PRESS, HYDROFORM (EQUIP. NO. 02654)**

DM-10031-1

1.256

44 6571 PKU

#2

MACHINE TOOL AND EQUIPMENT HISTORICAL RECORD						EQUIPMENT NUMBER 02622
PART I DESCRIPTION OF EQUIPMENT						
1. NOMENCLATURE PRESS BUSHING HYDRAULIC				2. MANUFACTURER Code 65871 Williams, White & Co.		
3. MODEL NUMBER 4433	4. SERIAL NUMBER C-2012	5. SIZE/CAPACITY 250 TON	6. COST 11218	7. DATE PURCHASED 1944		
8. P/N 49406403749						
PART II LOCATION						
WORK CENTER MASC (292MM)	BLOC NUMBER 375	ZONE CODE —	COLUMN G 32	REFERENCE TO COLUMN SAT. MOTOR #157	DATE INSTALLED —	
PART III MAINTENANCE COSTS AND REPAIRS						
DATE	TYPE MAINTENANCE	WORK ORDER NUMBER	COST			DOWN TIME PRODUCTION HOURS
			MATERIAL	LABOR	ACCUM TOTAL	
02-23-78	Electrical	R06735	—	288.25	288.25	1
2 MAY 78	Electrical	R09517A	—	424.88	713.13	2
10 MAY 78	"	R09517	—	145.84	858.97	3
17 JUN 78	MACH	R14225	—	556.00	1415.00	4
5 Oct 82	MACH & MACH	R3A941	Hydraulic Pump	931.56	2346.56	5
15 JUNE 83	ELECTRICAL	R16529	—	36.00	2382.56	6
27 Aug 83	Gen Mach	R20059	N/A	115.28	2497.84	7
21 Nov 84	MACH	R28033	Cylinder Temp.	92.34	2590.18	8
3 Nov 82	ELEC. & MACH.	R24932	-0-	62.18	2652.36	9
12 Dec 82	Mach	C-711	—	2.00	2654.36	10

TABLE B-3 MAINTENANCE DATA - PRESS, BUSHING HYDRAULIC  
(EQUIP. NO. 02622)

**TABLE B-4 MAINTENANCE DATA - PRESS. HYDRAULIC (EQUIP. NO. 02142)**

[illegible]

(75)

MACHINE TOOL AND EQUIPMENT HISTORICAL RECORD					EQUIPMENT NUMBER 00101	
<b>PART I DESCRIPTION OF EQUIPMENT</b>						
1. NOMENCLATURE MACHINE, BRAKE				2. MANUFACTURER WILSON (50875)		
3. MODEL NUMBER	4. SERIAL NUMBER	5. SIZE/CAPACITY	6. COST	7. DATE PURCHASED		
	72292	12'	30.765	1972		
8. P/N 3441 00 277 2105						
<b>PART II LOCATION</b>						
WORK CENTER	BLOC NUMBER	ZONE CODE	COLUMN	REFERENCE TO COLUMN	DATE INSTALLED	
MBPSC	375	124				
(222NM)						
<b>PART III MAINTENANCE COSTS AND REPAIRS</b>						
DATE	TYPE MAINTENANCE	WORK ORDER NUMBER	COST			DOWN TIME PRODUCTION HOURS
			MATERIAL	LABOR	ACCUM TOTAL	
05 JAN 79	MECH	R00342	-	109.43	109.43	
9 MAY 79	ELECT	R12813	-	43.96	153.46	
14 MAY 79	"	R13026	-	66.24	219.70	
11 JUN 79	ELECT	R15919	-	44.16	263.86	
6 JUL 79	MECH & ELECT	R18624	-	33.63	297.49	
10 SEP 79	MECH	R22133	-	78.42	375.91	
10 DEC 79	"	R31042	-	205.45	581.36	
3 APR 80	"	R07136	4.110000	66.25	647.61	
2 DEC 80	"	R37774	-	45.60	693.21	
1 JAN 81	CLAS	R12527	Repair Area door	47.32	740.53	
15 JUL 81	Mech	R23936	Roller assembly	393.60	1134.13	
6 MAR 83	"	R206217	-	157.44	1291.57	
8 APR 83	MECH	R09723	Jamming mechanism	214.72	1506.29	
16 MAY 83	MECH	R11751	ADJUSTMENT AND PARTS	647.22	2153.51	
10 JUN 83	MECH	R12411	-	25.10	2178.61	
10 JUL 83	"	R21108	-	17.00	2195.61	
10 JUL 83	"	R21108	-	17.00	2212.61	
79 JAN 85	MECH/ELEC	R26227	5.110000	719.36	3000.00	

TABLE B-6 MAINTENANCE DATA - MACHINE, BRAKE (EQUIP. NO. 00101)

[illegible]

DW-10051-1

M483 100925

(\* 7)

MACHINE TOOL AND EQUIPMENT HISTORICAL RECORD					EQUIPMENT NUMBER 02007	
<b>PART I DESCRIPTION OF EQUIPMENT</b>						
1. NOMENCLATURE BRAKE MACHINE			2. MANUFACTURER MF CODE 12374 CINCINNATI SHARP CO.			
3. MODEL NUMBER	4. SERIAL NUMBER	5. SIZE/CAPACITY	6. COST	7. DATE PURCHASED		
	—	12 FT	21,195.00	1942		
8. FSN 34412772105		1F 805668				
<b>PART II LOCATION</b>						
WORK CENTER	BLOG NUMBER	ZONE CODE	COLUMN	REFERENCE TO COLUMN	DATE INSTALLED	
MEPEC	375		23	SHEET METAL		
288NM			1-23	MANUFACTURING		
<b>PART III MAINTENANCE COSTS AND REPAIRS</b>						
DATE	TYPE MAINTENANCE	WORK ORDER NUMBER	COST			DOWN TIME PRODUCTION HOUR
			MATERIAL	LABOR	ACCUM TOTAL	
30-11-76	Repair	R 33516	10.50	32.50	43.00	4.0 hrs
21 Dec 76	Rebuild	R 353008	N/A	41.25	84.30	24.30
9-22-76		R 25556		841.12	125.42	
20 Jun 79	MECH	R 17019	—	66.20	191.66	
4 MAR 80	"	R 06027	—	22.50	214.16	
14 JAN 81	"	R 00647	—	52.50	272.75	
15 MAY 81	"	R 17270	Al. Brake drum	27.50	296.25	
10 SEP 81	mech	R 17725	Al. Brake drum	47.50	343.75	
20 MAR 82		R 00017	—	114.40	458.15	
23-11-82	Rebuild	R 00017	—	221.50	679.65	
25-11-82	mech	R 00017	—	53.40	733.05	
1 Jan 83	mech	R 031216	—	114.40	847.45	
18 APR 84	MECH.	R 10313	CAUTION SHIPPING	114.40	961.85	

TABLE B-8 MAINTENANCE DATA - MACHINE, BRAKE (EQUIP. NO. 02007)



TABLE B-9 MAINTENANCE DATA - SHEARING MACHINE (EQUIP. NO. 02446)

DW-10051-1

50-80313-5KA

#9

MACHINE TOOL AND EQUIPMENT HISTORICAL RECORD						EQUIPMENT NUMBER 02484	
PART I DESCRIPTION OF EQUIPMENT							
1. NOMENCLATURE <b>SHEAR MACHINE</b>				2. MANUFACTURER <b>COLUMBIA MACHINE &amp; ENG.</b>			
3. MODEL NUMBER	4. SERIAL NUMBER	5. SIZE/CAPACITY	6. COST	7. DATE PURCHASED			
	<b>W-175-9</b>		<b>17,572.00</b>	<b>1950</b>			
8. PSN <b>3445 00 262 4243</b>		<b>AFTAC 805676</b>					
PART II LOCATION							
WORK CENTER	BLOG NUMBER	ZONE CODE	COLUMN	REFERENCE TO COLUMN	DATE INSTALLED		
<b>M.B.P.S.C.</b>	<b>375</b>		<b>J22</b>				
PART III MAINTENANCE COSTS AND REPAIRS							
DATE	TYPE MAINTENANCE	WORK ORDER NUMBER	COST			DOWN TIME PRODUCTION HOURS	
			MATERIAL	LABOR	ACCUM TOTAL		
01-02-77	Rope/Carb	R 21759	N/A	28.25	28.25		
01-02-77	mach Sup	R 05539	N/A	32.85	61.10		
05-03-77	Hydrazine	R 02351	N/A	16.20	77.30		
17 MAY 78	Reb. kn	R 0123P	—	122.52	200.82		
31 MAY 78	Correction	R 14409	—	20.24	221.06		
1 Nov 78	ELECTRICAL	R 26546	—	43.44	264.50		
11-30-78	MESH	R 31242	—	70.52	335.02		
04 JAN 79	"	R 00215	—	54.22	389.24		
5 OCT 79	"	R 27722	—	58.25	447.49		
10 JAN 80	CORRECTIVE	R 3413A	—	141.60	589.09		
17 JAN 80	Repair	R 36113	—	186.80	775.89		
13 MAR 80	Mesh	R 15753	—	22.20	802.09		
10 APR 81	ELEC	R 09809	Repair Glass	23.20	825.29		
29 APR 81	ELECTRICAL	R 10539	—	22.83	848.13		
31 APR 81	Mesh	R 23310	Repair Wires	115.20	963.33		
10 NOV 81	MACH.	R 29250	—	96.32	1059.65		
7 DEC 81	ELEC	R 32214	Repair Pot. 100V	72.24	1131.89		
2 MAR 82	MACH + MACH	R 26733	Change clearance	159.64	1291.53		
15 Apr 82	MACHINIST	R 09037	Columbia Shear	49.12	1340.65		
22 Nov 82	DIAGNOSTIC	R 29933	—	206.08	1546.73	2	
23 Nov 82	MACH	R 28125	15.00	204.70	1751.43	7	
11 Dec 82	"	R 28125	—	204.70	1956.13	6	
22 Dec 82	"	R 28125	—	204.70	2160.83	2	
5 Dec 83	MACH	R 22604	—	101.42	2262.25	2	
12 Dec 83	"	R 22604	100V	101.42	2363.67	7	
29 MAR 84	"	R 22604	100V	101.42	2465.09	2	
30 MAR 84	"	R 22604	100V	101.42	2566.51	6	
31 OCT 84	MACH	R 26326	—	1	2567.51	20	

TABLE B-10 MAINTENANCE DATA - SHEARING MACHINE (EQUIP. NO. 02484)

DW-10051-1

0437

14

[illegible]

TABLE B-11 MAINTENANCE DATA - PRESS PUNCH (EQUIP. NO. 02214)

17

EQUIPMENT NUMBER	02593
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### DESCRIPTION OF EQUIPMENT

1. NOMENCLATURE Machine		Hole Punching and Notching		2. MANUFACTURER Houdaille Industries		Strippit Division- EC-50155	
3. MODEL NUMBER 76001		4. SERIAL NUMBER 47553072		5. SIZE/CAPACITY 18" Max Hole Dia = 3.5" ID		6. COST \$12,328	
7. DATE PURCHASED 1972		8. FEN 3445-00-879-1352		34C2-7-9-1,12,22			

**LOCATION**

WORK CENTER	BLOC NUMBER	ZONE CODE	COLUMN	REFERENCE TO COLUMN	DATE INSTALLED
MOPSC 288 NM	375		G-24	W17ET	

### MAINTENANCE COSTS AND REPAIRS

[illegible]

AFLC-WHAFB-JAN 72 0200

TABLE B-13  
MACHINE MATRIX (EXISTING)

PAGE 1 OF 4

\* - REFURBISHMENT COST NOT DETERMINED  
D - MAINTENANCE DATA SUPPLIED.

ITEM	INCIDENTAL	SIZE AND IDENTIFICATION	MANUFACTURER	YEAR OF DELIVERY	ROM	RECOMMENDATIONS
1	HYDROFORM PRESS HYDRAULIC FLEXIBLE DIE	2,750 TON 25" BLANK CATALOG NO. 70-300F-005-1	CINCINNATI MILLING MACHINE COMPANY	1972	---	MAINTAIN OR REFURBISH
2	PRESS HYDRAULIC	250 TON SERIAL NO. C-2018	WILLIAM-WHITE 700 THIRD AVE. MOLINE, ILLINOIS 61265 309-797-7650	1944	---	SALVAGE COMPONENTS THAT COULD BE USED TO SUPPORT ITEM 4 AND SCRAP
3	PRESS HYDRAULIC	220 TON SERIAL NO. 1495	LAKE ERIE ENGR. BUFFALO, N.Y.	1939	---	SURPLUS OR SALVAGE COMPONENTS THAT COULD BE USED TO SUPPORT ITEM 4 AND SCRAP
4	PRESS	500 TON, CONTRACT NO. F00603-72-C-4836 CATALOG NO. C-4037 MODEL 500T	WILLIAM-WHITE 700 THIRD AVE. MOLINE, ILLINOIS 61265 309-797-7650	1973	\$30,000 AND 800 MANHOURS	REFURBISH ADD TWO EACH FEED TABLES AND TRAPPED RUBBER HEAD
5	PRESS BRAKE	150 TON, 12 FOOT 3" STROKE, CATALOG NO. 12 FN 150, SERIAL NO. 72292	WISCONSIN MACHINE CORP. MEDFORD, WISCONSIN	1972		SURPLUS OR SALVAGE COMPONENTS THAT COULD BE USED TO SUPPORT ITEM 6 AND THEN SCRAP
6	PRESS BRAKE	50 TON, 6 FOOT THROAT 3" STROKE, CATALOG NO. 6 FN 75, SERIAL NO. 74507, 3441-00-812-5217	WISCONSIN MACHINE CORP. MEDFORD, WISCONSIN	1940	MOVE COST	MAINTAIN
7	PRESS BRAKE	360 TON, 12 FOOT THROAT CONTRACT NO. 3441-82 3441-00-277-2105 U.S.A.F. 805668	CINCINNATI SHAPER CO.	1942	MOVE COST	MAINTAIN UNTIL DELIVERY AND INSTALLATION OF 12" MC BRAKE PRESS, THEN REFURBISH BY REPLACING CRACKED STRUCTURE

TABLE B-13  
MACHINE MATRIX (EXISTING)

B - MAINTENANCE DATA SUPPLIED.

PAGE 2 OF 4

ITEM	DESCRIPTION	SIZE AND IDENTIFICATION	MANUFACTURER	YEAR OF DELIVERY	ROM	RECOMMENDATIONS
8	SHEAR	12 FOOT, 3/8" MILD STEEL 24" THROAT DEPTH CONTRACT NO. F09603-72- C-4452, CATALOG NO. S-0612, SERIAL NO. 40041	LODGE AND SHIPLEY CO.	1972	MOVE COST DURING SHOP UPDATE	MAINTAIN
9	SHEAR	12 FOOT, 3/8" MILD STEEL 3445-00-242-4243 CATALOG NO. 0612 SERIAL NO. W-175-9 U.S.A.F. 805676	COLUMBIA MACHINERY AND ENGINEERING CORP. MAMILTON, OHIO	1950	DEMOLITION COST	SCRAP
10	PUNCH PRESS	CONTRACT NO. 3443-6 3443-00-490-9118 U.S.A.F. 805689	ROPER WHITNEY METAL TOOLS ROCKFORD, ILLINOIS	OLD	DEMOLITION COST	SCRAP
11	PUNCH PRESS	55 TON, SERIAL NO. UPPER LEFT, MAND BY GIBS GOLD TAG, 3143-10-24975- 2153	WALSH PRESS AND DIE CO. CHICAGO, ILLINOIS DIVISION OF AMERICAN GAGE AND MACHINE CO. 1222 SOUTH WYOMING FOREST PARK, ILL. 60130 312-378-6700	OLD	DEMOLITION COST	SCRAP
12	PUNCH PRESS	SIZE NOT AVAILABLE U.S.A.F. 302833 SERIAL NO. STAMPED LEFT OR RIGHT SIDE OPPOSITE CONTROLS TYPICAL NO. MP-XXXX-VR, H-XXXX-VR	E.W. BLISS CO.	OLD	MOVE COST	MAINTAIN

B - MAINTENANCE DATA SUPPLIED. PAGE 3 OF 4

TABLE B-13  
MACHINE MATRIX (EXISTING)

ITEM	DESCRIPTION	SIZE AND IDENTIFICATION	MANUFACTURER	YEAR OF DELIVERY	ROOM	RECOMMENDATIONS
13	PUNCH PRESS	150 TON, 30" STROKE 4" ADJUST, 24" SHUT HEIGHT, 10 STROKE/MINUTE CATALOG NO. F1150-4 U.S.A.F. 805044	CLEARING MACHINE CO. 6499 W. 65TH ST. CHICAGO, ILL. 60638	OLD	DEMOLITION COST	SCRAP
14	PUNCH PRESS	231 X 15 SERIAL NO. 31274	NIAGARA MACHINE & TOOL NORTHLAND & LONGVIEW AVES., BUFFALO, N.Y. 14211 716-893-4070	1935	MOVE COST	MAINTAIN
15	PUNCH PRESS	71 TON, 4" STROKE 15.75" SHUT HEIGHT 3" ADJUSTMENT, 42 STROKES/MINUTE CATALOG NO. M-1/2 SERIAL NO. 31996	NIAGARA MACHINE & TOOL NORTHLAND & LONGVIEW AVES., BUFFALO, N.Y. 14211 716-893-4070 MESSENDORF, HELMS & CO. HOUSTON, TEXAS	OLD	MOVE COST	MAINTAIN
16	PUNCH PRESS	NOTEX, CATALOG NO. 2400 15 TON, 26" THROAT 27/32" HOLE IN MILD STEEL 3445-312-5212	NOTEX PUNCH COMPANY, INC. 2350-B ALVARADO ST. SAN LEANDRO, CA. 94577 415-357-3500	1974	MOVE COST	MAINTAIN UNTIL NUMERICALLY CONTROLLED PUNCH PRESS IS OPERATIONAL AND COMPANION DIGITAL GENERATION CAPABILITY IN HAND, THEN SCRAP
17	PUNCH PRESS	STRIPPIT, 18 TON 18" THROAT, .25" MAX. THICK, MATERIAL CATALOG NO. 18/30 SONIC 76001 SERIAL NO. 47553072 CONTRACT NO. F09603-72- C-9606	STRIPPIT MOUDAILLE ACRON, N.Y.	1972	MOVE COST	SAME AS FOR ITEM 16

TABLE B-13  
MACHINE MATRIX (EXISTING)

B - MAINTENANCE DATA SUPPLIED.

PAGE 4 OF 4

ITEM	DESCRIPTION	SIZE AND IDENTIFICATION	MANUFACTURER	YEAR OF DELIVERY	ROM	RECOMMENDATIONS
18	DAND SAW	DO ALL, 36" THROAT, 234" BLADE, 1290 FEET/MINUTE, 3405-00-528-8609 SERIAL NO. 31-52981	DO ALL ATLANTA, GA. 404-688-4114	1982	MOVE COST	MAINTAIN
19	DAND SAW	DO ALL, 36" THROAT, 234" BLADE, 1290 FEET/MINUTE, CONTRACT NO. F09603-82-C-6072 SERIAL NO. 399-83491	DO ALL ATLANTA, GA. 404-688-4114	1982	MOVE COST	MAINTAIN
20	DRAP MOWER					MAINTAIN
21	NUMERICALLY CONTROLLED ROUTER DRILLER	48" X 144" GANTRY 8" Z AXIS	EKSTROM CARLSON	1986	INSTALLATION COST	CONSUMABLES - ROUTER BITS, DRILL BITS, AND COOLANT. REQUIRES NUMERICAL CONTROL DATA SETS. RECOMMEND ADDING 3/4 TON AIR CONDITIONING TO COOL ELECTRONIC PACKAGE. (POWER REQUIRED TO RUN AIR CONDITIONER .56 KW.)



TABLE B-14  
MACHINE MATRIX (NEW)

PAGE 1 OF 3

ITEM	NOMENCLATURE	SIZE AND IDENTIFICATION	DATA SOURCE	EXPECTED DELIVERY	ROM	CONSUMABLES
22	NUMERICALLY CONTROLLED PROFILE FABRICATOR PUNCH PRESS	48" X 48" TABLE M-3050 OR EQUAL	WIEDEMATIC OR STRIPIT	26 WEEKS	\$200,000	REQUIRES ONE TIME PURCHASE OF PUNCHES
23	DIGITIZING SYSTEM	TRANSLATOR	EKSTRON CARLSON	26 WEEKS	\$28,000	PLOTTER PAPER, PRINTER PAPER, PLOTTER PENS
24	TAPE PUNCH		DATE SYSTEMS	OFF THE SHELF	\$5,000	TAPE, MYLAR OR PAPER
25	SHEET METAL MAIN FRAME COMPUTER	2,000K	HEWLETT PACKARD, OR IBM, OR AT&T, OR ZENITH	OFF THE SHELF	\$3,300	
26	NESTING SOFTWARE FOR MASTER LAYOUT TO BE USED WITH ITEM 23	MINIMIZES SCRAPE WHEN LAYING OUT SHEETS FOR ITEM 22	EKSTRON CARLSON	OFF THE SHELF	\$60,000	MAGNETIC MEDIA TO STORE BACK UP COPY OF SOFTWARE
27	ROLL PLOTTER	48" WIDE X 144" LONG FULL SIZE SHEET LAYOUT AND VERIFICATION	HEWLETT PACKARD, OR EKSTRON CARLSON, OR CALCOMP	26 WEEKS	\$17,000	ROLL PAPER, ROLL MYLAR AND SHEETS, PENS
28	CRT DISPLAY JOBS IN	15" DIAGONAL AND CARD RACK	SAME AS ITEM 25	OFF THE SHELF	\$1,000	PUNCH CARDS
29	CRT DISPLAY JOBS OUT	15" DIAGONAL AND CARD RACK	SAME AS ITEM 25	OFF THE SHELF	\$1,000	PUNCH CARDS

TABLE B-14  
MACHINE MATRIX (NEW)

PAGE 2 OF 3

ITEM	DESCRIPTION	SIZE AND IDENTIFICATION	DATA SOURCE	EXPECTED DELIVERY	ROM	CONSUMABLES
30	COMPATIBILITY SOFTWARE TO LINK MC ROUTER AND MC PUNCH PRESS	N/A	EKSTROM CARLSON	26 WEEKS	\$25,000	NONE
31	NUMERICALLY CONTROLLED SHEAR	12 FT. LENGTH	STRIPPIT	26 WEEKS	\$24,300	REQUIRES ONE TIME PURCHASE OF SHEAR BLADES
32	HYDRAULIC PRESS 150 TON WITH TWO EACH FEED TABLES, BRAKE	48" X 48" WORKING AREA UNDER TRAPPED RUBBER HEAD	DAKE	26 WEEKS	\$105,000 PLUS TRAPPED RUBBER HEAD	HYDRAULIC FLUID, MISC. LUBRICANTS, RUBBER FOR TRAPPED RUBBER HEAD, NOSITE RUBBER WEAR PADS
33	SKIN STRETCH PRESS, NUMERICALLY CONTROLLED	96" X 260", 200 TON	CYRIL BATH COMPANY	26 WEEKS	\$1,350,000	HYDRAULIC FLUID, MC TAPES, MISC. LUBRICANTS
34	EXTENSION STRETCH PRESS	6" X 144"	CYRIL BATH COMPANY	26 WEEKS	\$265,000	HYDRAULIC FLUID, MC TAPES, MISC. LUBRICANTS
35	NUMERICALLY CONTROLLED PRESS BRAKE	12 FEET	STRIPPIT	26 WEEKS	\$46,000	REQUIRES ONE TIME PURCHASE OF BRAKE FORM TOOLS
36	NUMERICALLY CONTROLLED PRESS BRAKE	6 FEET	STRIPPIT	26 WEEKS	\$31,800	REQUIRES ONE TIME PURCHASE OF BRAKE FORM TOOLS
37	NUMERICALLY CONTROLLED PRESS BRAKE	4 FEET	STRIPPIT	26 WEEKS	\$26,000	REQUIRES ONE TIME PURCHASE OF BRAKE FORM TOOLS

TABLE B-14  
MACHINE MATRIX (NEW)

PAGE 3 OF 3

ITEM	NOMENCLATURE	SIZE AND IDENTIFICATION	DATA SOURCE	EXPECTED DELIVERY	ROM	CONSUMABLES
38	NOT FORM PRESS	48 X 48 C PRESS 1800P	MURDOCK	26 WEEKS	\$700,000	ELECTRICAL HEATING ELEMENTS, HYDRAULIC FLUID, MISC. LUBRICANTS
39	FASTER LINE STRIPPIT PUNCH TOOLING SET (USED WITH ITEMS 35, 36, AND 37)	6 FEET LONG ON 2 INCH CENTER PILOT PUNCHES	STRIPPIT	6 WEEKS	\$10,000	REQUIRES ABRASIVES FOR TOOLS AND FIXTURES UNIT TO RESHARPEN PUNCHES
40	FLUID CELL PRESS	QCF 400-100	ASEA	78 WEEKS	\$2,500,000	HYDRAULIC FLUID, WEAR PADS, BLADDER, MISC. LUBRICANTS
41	CAD/CAM TERMINAL		SAME AS EXISTING SA-ALC CAD/CAM TERMINAL	26 WEEKS	\$48,000	USES CONSUMABLES LISTED IN ITEMS 23 AND 27

TABLE 3-15  
ELECTRICAL POWER REQUIREMENTS

Page 1 of 3

NEW EQUIPMENT

ITEM	DESCRIPTION	VOLTAGE/Hz	PHASE	LINE CURRENT/AMPS P.F. = 0.9	POWER/KW	DATA SOURCE
22	NUMERICALLY CONTROLLED PROFILE CAMERATOR FUNCTIONS	200/160 60Hz + 10% 115 VOLT 60Hz	3	118/59 MINIMUM 140/70 PEAK	MINIMUM 42 PEAK 50 .55	WIEDMATIC W 3050 PEAK .3 SECOND WITHOUT CAUSING 10% DROP IN LINE VOLTAGE. RECOMMEND TRANSIENT SUPPRESSION ON CONTROL SYSTEM. RECOMMEND ADDING 3/4 TON AIR CONDITIONING TO COOL ELECTRONIC PACKAGE (.50KW)
23	DICTATING SYSTEM TRANSLATOR II	115 60Hz	1	7.6	.89	RECOMMEND TRANSIENT SUPPRESSION EXSTRON, CARLSON, AND COMPANY ROCKFORD, ILLINOIS
24	TYPE PUNCH	115/230 60/60Hz	1	1.6/.8	.15	+ 2HZ, OPTION J 100/200 VAC, + 10% SELECTABLE, RECOMMEND TRANSIENT SUPPRESSION DATA SPECIALITIES, NORTHBROOK, ILLINOIS
25	SHEET FEED PUNCH COMPUTER	115 60Hz	1		.42 ESTIMATE	RECOMMEND TRANSIENT SUPPRESSION
26	RETTING SOFTWARE FOR NUMBER LAYOUT TO BE USED WITH ITEM 25					NOT APPLICABLE
27	ROLL PUNCH	115 60 Hz	1		.12	RECOMMEND TRANSIENT SUPPRESSION. 10-40GT CAL CO. E.
28	CRT DISPLAY JOBS IN	115 60Hz	1		.12	ESTIMATED

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TABLE B-15  
ELECTRICAL POWER REQUIREMENTS

Page 2 of 3

NEW EQUIPMENT

ITEM	DESCRIPTION	VOLTAGE /HZ	PHASE	LINE CURRENT/AMPS P.F. = 0.9	POWER/KW	DATA SOURCE
29	CRT DISPLAY JOBS OUT	115 60HZ	1		.12	ESTIMATED
30	COMPATIBILITY SOFTWARE TO LINK MC ROUTER AND M.C. PUNCH PRESS					NOT APPLICABLE
31	NUMERICALLY CONTROLLED SHEAR	230/460 60HZ	3	15.62/7.81	5.60	STRIPPIT 7.5 HP. MOTOR
32	HYDRAULIC PRESS 150 TON	230/460	3	52.02/26.01	18.65	DAKE 25 H.P. MOTOR
33	SKIN STRETCH PRESS	220/440 60HZ	3	369.80/184.90	126.82	400 TON CYRIL BATH VT400 2 EACH 60 H.P. & 1 EACH 50 H.P. MOTORS CAN START INDIVIDUALLY
34	EXTENSION STRETCH PRESS	220/240 60HZ	3	117.49/58.75	40.29	30 TON CYRIL BATH V30 50 H.P. & 2 EACH 2 H.P. MOTORS CAN BE STARTED INDIVIDUALLY
35	12' NUMERICALLY CONTROLLED PRESS BRAKE	220/240	3	32.63/16.32	11.19	STRIPPIT 15 HORSE POWER MOTOR
36	6' NUMERICALLY CONTROLLED PRESS BRAKE	220/240	3	11.99/5.99	4.11	STRIPPIT 5.5 HORSE POWER MOTOR

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TABLE B-15  
ELECTRICAL POWER REQUIREMENTS

Page 3 of 3

NEW EQUIPMENT

ITEM	DESCRIPTION	VOLTAGE / HZ	PHASE	LINE CURRENT/AMPS P.F. = 0.9	POWER/KW	DATA SOURCE
37	4' NUMERICALLY CONTROLLED PRESS BRAKE	220/240 60HZ	3	11.99/5.99	4.11	STRIPPIT 5.5 HORSE POWER MOTOR
38	HOT FORM PRESS	480 ± 5%	3	320.75	240	100 TON 48 x 48 PLATEN 1800°F MURDOCK COMPTON, CALIFORNIA
39	FASTNER LINE PUNCH TOOLING SET					NOT APPLICABLE
40	FLUID CELL PRESS	460 60HZ	3	460.21	330	ASEA 110 SECOND CYCLE TIME ASEA WHITE PLAINS, NEW YORK
41	CAD/CAM TERMINAL	115 60HZ	1		.14	RECOMMEND TRANSIENT SUPPRESSION AT&T
					832.74	TOTAL

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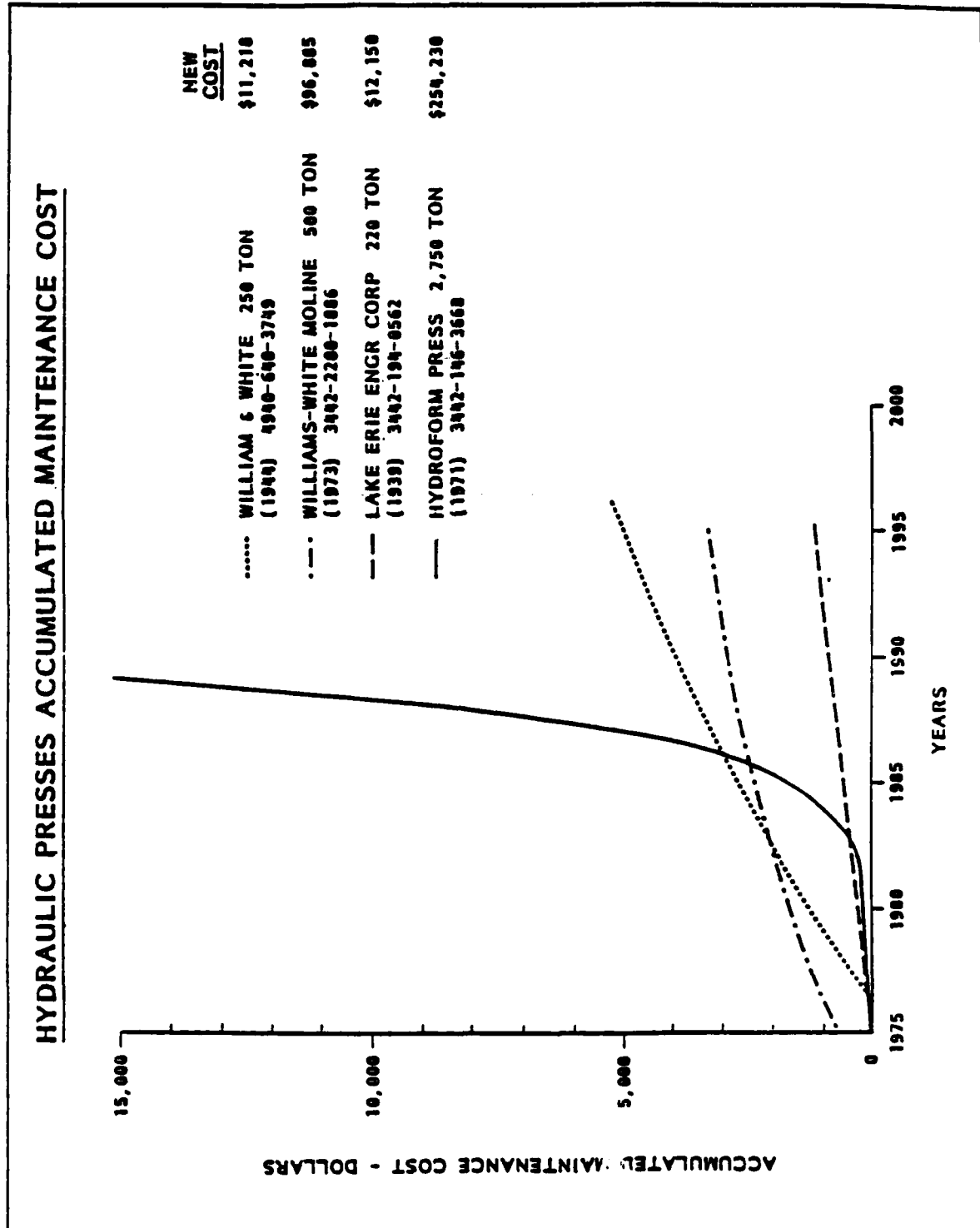


FIGURE B-1 MAINTENANCE DATA - PRESSES

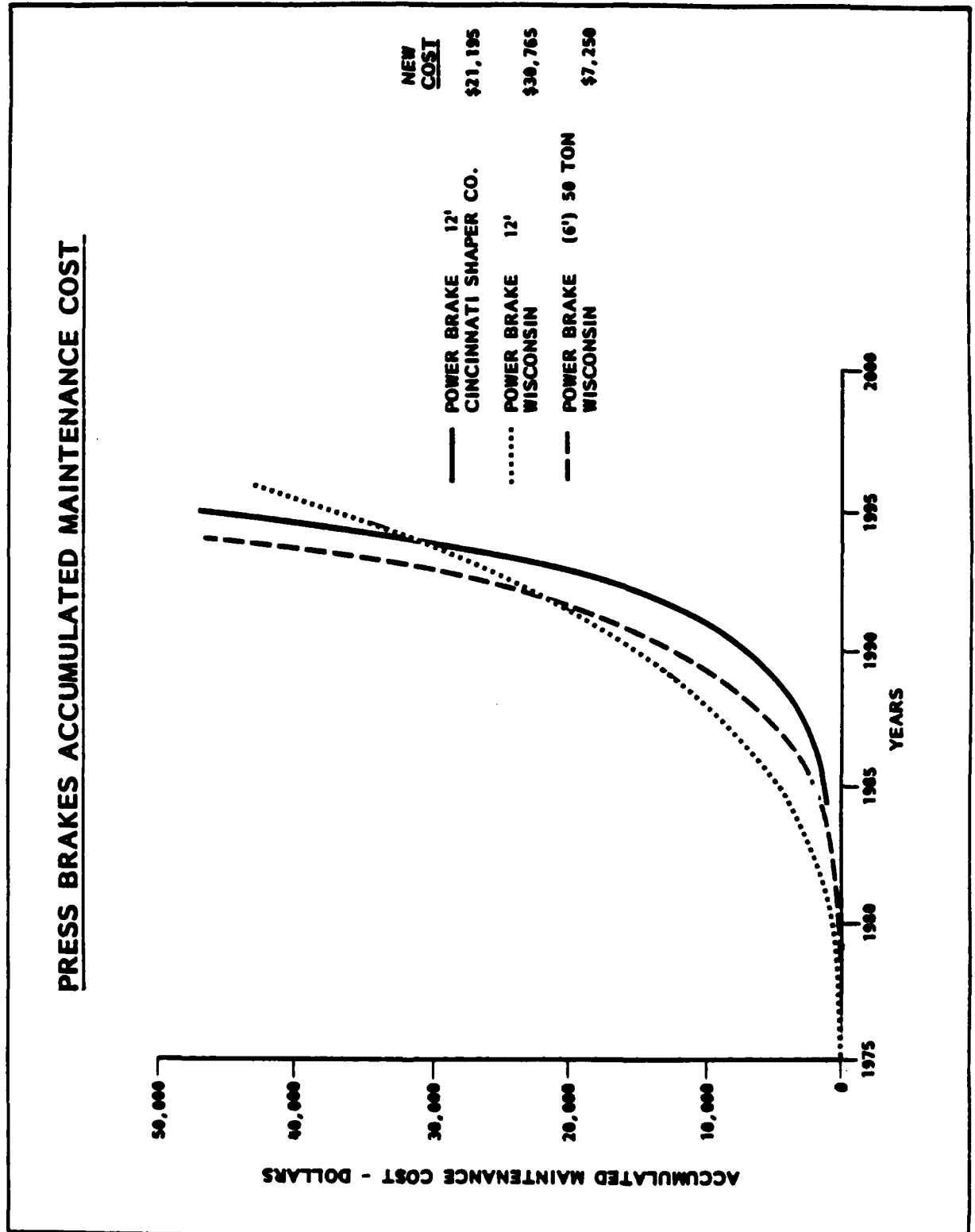


FIGURE B-2 MAINTENANCE DATA - BRAKES



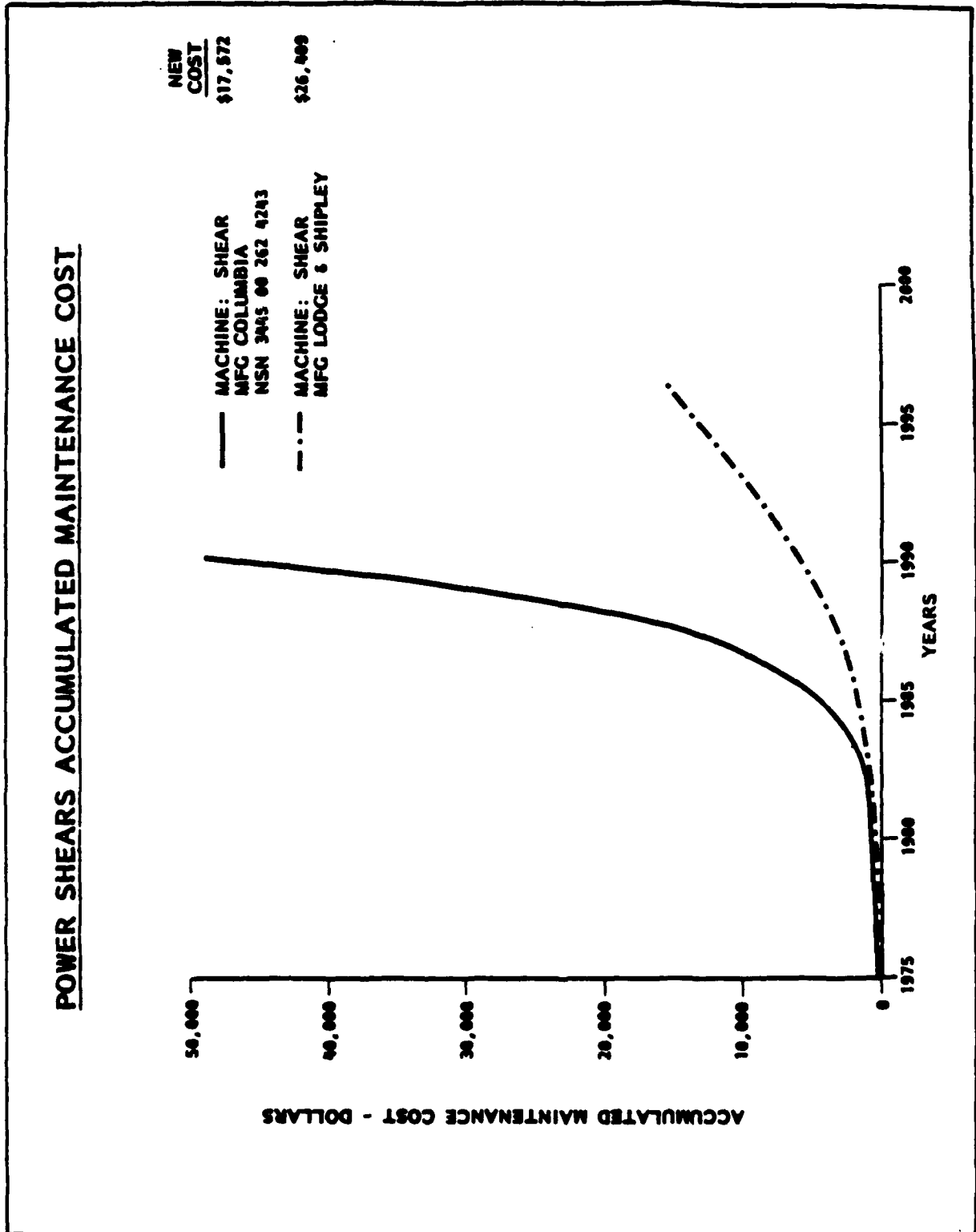


FIGURE B-3 MAINTENANCE DATA - SHEARS

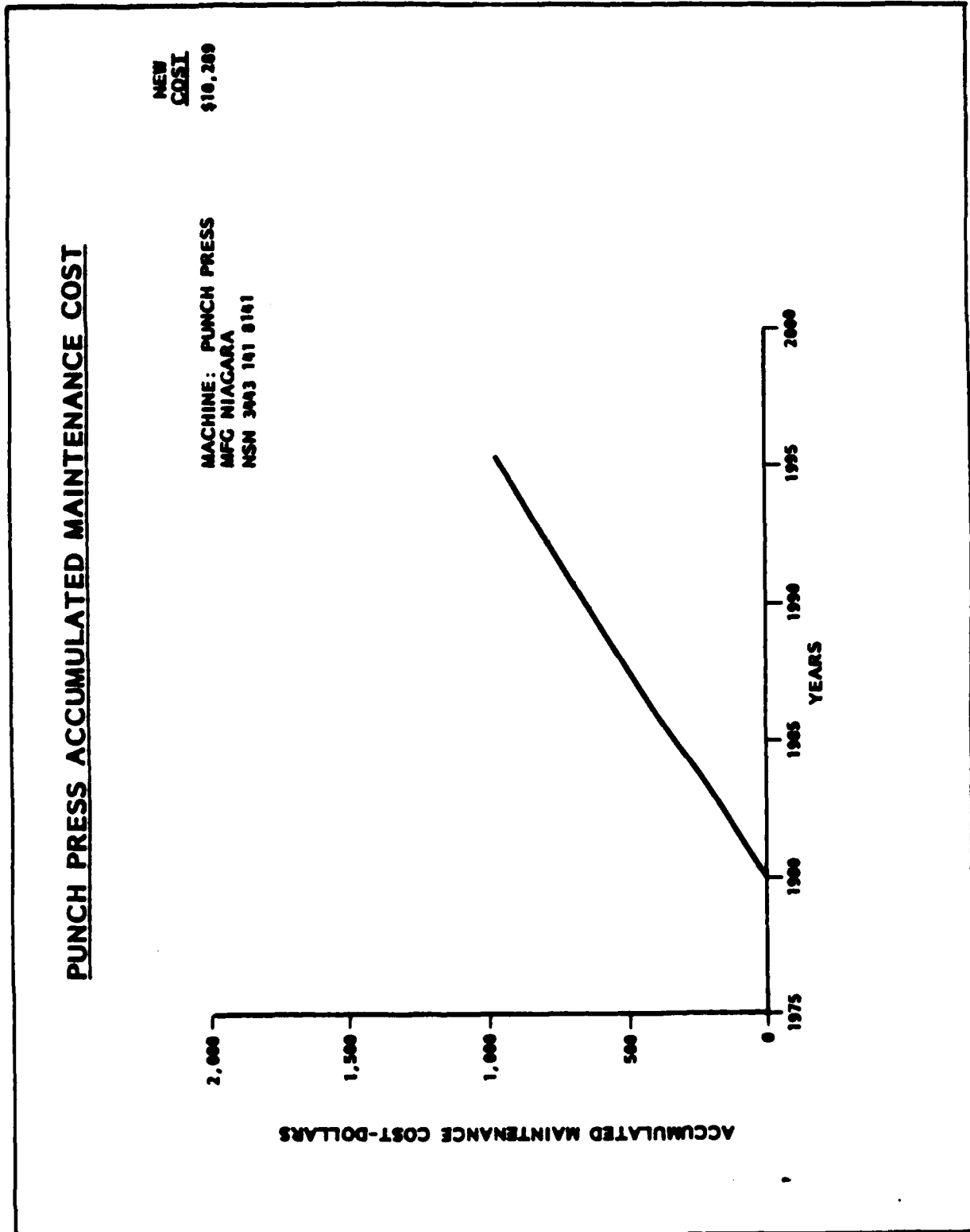


FIGURE B-4 MAINTENANCE DATA - PUNCH PUNCH

ITEM	1	2	3	4	5	6	7

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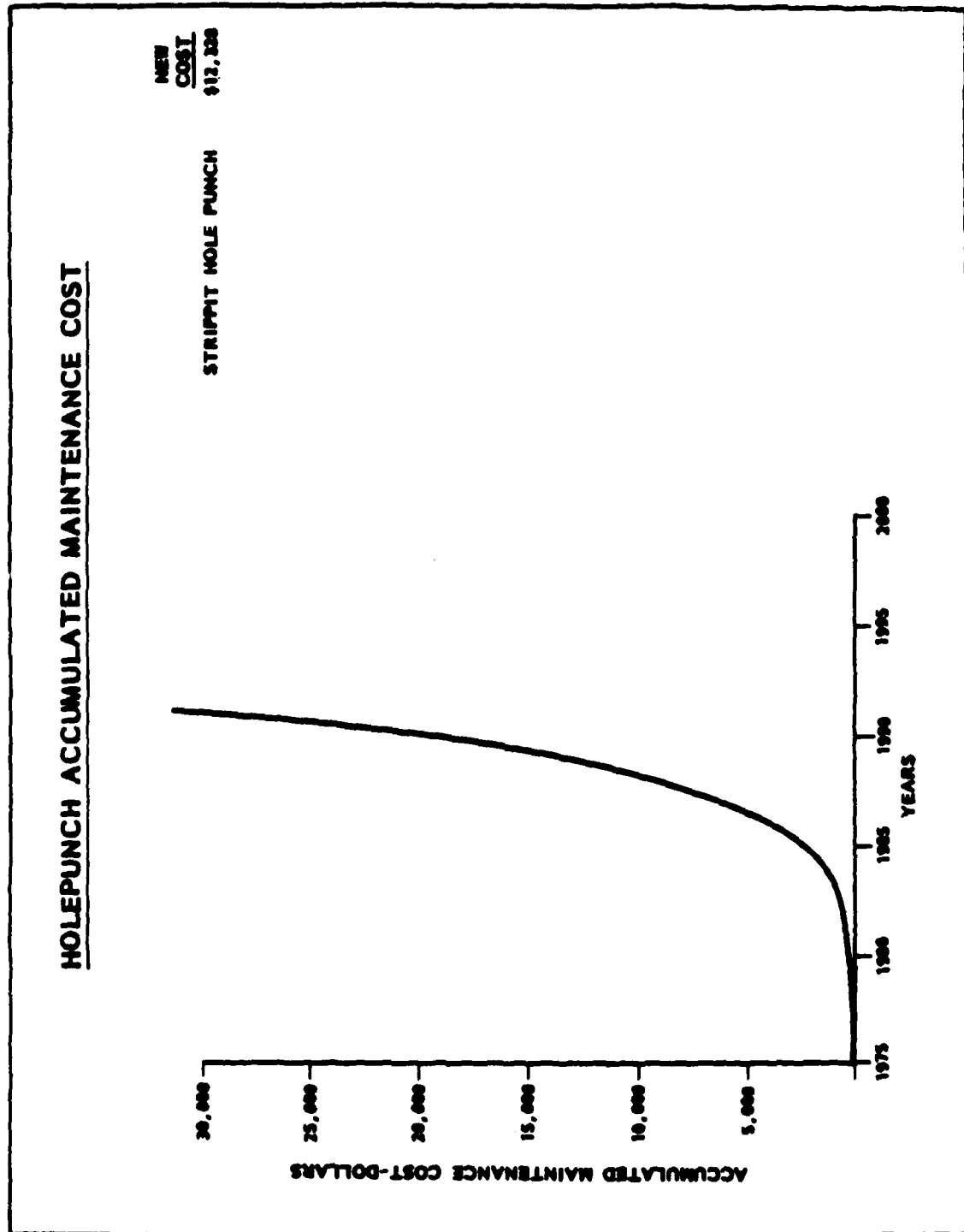


FIGURE B-5 .MAINTENANCE DATA - HOLE PUNCH